

2008 Nitrate Priority Area Delineation and Ranking Process



Department of Environmental Quality

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Introduction

Pursuant to guidance provided in the Department of Environmental Quality (DEQ) policy memorandum entitled “Policy for Addressing Degraded Ground Water Quality Areas” dated March 1, 2000, a statewide list of significantly degraded areas with nitrate was developed. In 2002, the DEQ, in cooperation with the Idaho Ground Water Monitoring Technical Committee (GWMTC) published a ranking of 25 Nitrate Priority Areas (NPAs). The NPAs are areas where elevated levels of nitrate have been found in ground water.

DEQ, in conjunction with the GWMTC revised the NPAs published in 2002. The revisions utilized data collected since the original NPAs were developed to evaluate ground water quality changes in existing NPAs and to identify new areas with nitrate degraded ground water. In the summer of 2006 the GWMTC began the process of revising the NPAs. Based on experience gained since 2002, which provided agencies with a better understanding of the resources necessary to address ground water degradation over large areas, it was decided to limit the effort to delineating only Priority 1 NPAs and not include Priority 2 NPAs.

The minimum criterion for a Priority 1 NPA is 25% of sampled wells have nitrate levels at or above 5 milligrams per liter (mg/L). The state and federal drinking water standard, as well as the Idaho Ground Water Quality Standard for nitrate is 10 mg/L. Within a Priority 2 NPA 50% of the sampled wells have nitrate levels at or above 2 mg/L. Almost all developed areas of the state meet this criterion.

Phase I – Data Acquisition, Compilation, and Analysis

In the fall of 2006, DEQ began collecting and compiling nitrate results and well location data from the numerous agencies monitoring ground water in Idaho. Well location information, sampling date, and nitrate concentrations data were received and compiled by DEQ. Spatial information was reconciled and integrated into a GIS.

Sources of data included the DEQ public water system database, the Statewide Ambient Ground Water Quality Monitoring Network (Statewide Program), numerous U.S. Geological Survey (USGS) studies, DEQ regional and local monitoring projects, regional studies conducted by the Idaho State Department of Agriculture (ISDA), and dairy sampling by ISDA. Data from 1990 into 2007 were plotted and assigned a nitrate value. The 2002 NPAs were based on data from 1974 to 2000. The use of more recent data resulted in a difference of sample numbers between the 2002 and 2008 NPA analysis within a few areas with roughly the same configuration, namely Fort Hall and Bruneau. For sites with multiple values the most recent value was used. Data from site-specific monitoring projects associated with known point sources of nitrate contamination were not included in the data set.

Ground water quality data from about 9,950 wells statewide were compiled and evaluated to develop the 2008 NPAs. The NPAs contain 3,600 of the 9,950 wells and encompass a combined area of 2,229,048 acres. Approximately 300,000 people are estimated to live within the boundaries of the NPAs.

Phase 2 – Delineation of Nitrate Priority Areas

Once the data was located spatially and a value was assigned to each location, the NPAs were delineated. The GWMTTC reviewed a variety of approaches and discussed pros and cons of different methods to delineate NPAs. A single method, which would provide concise, objective, and have scientifically defensible boundaries, was the ultimate goal of the GWMTTC. The GWMTTC after much discussion and multiple attempts to use a single method determined that a triad of three different methods provided the best result. To decrease the reliance on the potential subjectivity of professional judgment, two geostatistical methods, indicator kriging and ordinary kriging, were incorporated in the process. Geostatistical software packages for indicator kriging and ordinary kriging, available for ESRI® ArcMap™, were applied to the data. The two geostatistical techniques and professional judgment factors are described in very simplified terms below.

- Indicator kriging considers if a value is above or below a specific concentration. It analyzes the data and shows the probability of exceeding a specific concentration. The method allows the user to use any combination of probability and concentration. For this process a 25% probability of exceeding 5 mg/L for nitrate was used.
- Ordinary kriging interpolates values between locations with data and contours the data. Areas located within the contour interval of 3.5 mg/L were used.
- The third component of the process included professional judgement. This component included the consideration of land use and knowledge of aquifers and hydrogeologic factors. For example, efforts were made to not extend NPA boundaries into undeveloped lands.

The utilization of geostatistical methods provided more objective and scientifically defensible boundaries. It should be noted that the NPA boundaries are considered estimations that identify general areas where nitrate levels are more likely to be elevated. NPAs may be considered analogous to climate zones or precipitation maps, which constantly change. Distinct NPA boundaries may not be appropriate because of the dynamic nature of ground water systems. Nitrate levels may fluctuate seasonally or annually for a number of reasons including flow direction or water level changes in response to irrigation practices or seasonal land use practices. Additionally, because nonpoint sources of contamination do not have distinct contamination plumes like point source releases, the boundaries of NPAs are not definite.

The delineation process yielded 32 Priority 1 NPAs, located statewide stretching from Nez Perce County in Northcentral Idaho to Franklin County in Southeast Idaho and from Owyhee County in Southwest Idaho to Fremont County in Eastern Idaho. The spatial distribution of NPAs is very similar to the distribution in 2002. Figure 1 is a map showing a comparison between the 2002 and 2008 NPAs. Some of the increase in the number of NPAs is the result of splitting some of the larger NPAs in the Treasure Valley into smaller NPAs. For example the 2002 Homedale-Marsing NPA was separated into two NPAs: one Homedale and one Marsing. The separation was based on data showing an area with lower nitrate concentration located between the two NPAs.

New NPAs, not divided from larger areas, that were identified by more recent data include: the Lindsay Creek area near Lewiston; an area in Gem County; areas west of Middleton; Mountain Home Air Force Base; Hagerman; an area east of Blackfoot, and the Mink Creek drainage to the south of Pocatello.

Based on more recent sampling, two of the 2002 lower ranking NPAs were removed from the NPA list because the results did not meet the criterion of 25% of sampled wells at or above 5 mg/L. These areas include Genesee/Cow Creek located to the north of Lewiston, and Hibbard near Rexburg.

Phase 3 – Nitrate Priority Area Ranking

The process used to rank the NPAs in 2002 was also used to rank the 2008 NPAs. The GWMTC supported the continued use of the ranking process to maintain consistency with previous efforts. Additionally, ranking the process used in 2002 went through a 60-day public comment and was revised based on comments received during that period.

The NPA Ranking Process (Ranking Process), developed by DEQ, in consultation with the Ground Water Monitoring Technical Committee (GWMTC), provides the rationale for numerically ranking areas in Idaho with identified ground water degradation from nitrates. The statewide priority list created through this process will be used to prioritize the implementation of protective management strategies or corrective action measures within the Nitrate Priority Areas.

The ranking process employed an approach intended to:

- Minimize subjectivity
- Have statewide applicability
- Be transferable to other types of contaminants, such as pesticides, and
- Use existing information.

The ranking process considers three weighted principal criteria: population, existing water quality, and water quality trends. A secondary criterion, impacts to beneficial uses other than potable water supply, is considered to a lesser extent because it is not directly related to public health. The secondary criterion is included to comply with the DEQ Policy Memorandum entitled "Policy for Addressing Degraded Ground Water Quality Areas."

Criteria and Scoring Format

The criteria and scoring format are described below.

Primary Criterion

- 1) **Population** - The population criterion considers the number of people living in an area that are potentially drinking nitrate-degraded water. This criterion consists of an assessment and point assignment of three elements.

- a. Population within the priority area. This element is based upon census data. From 1 to 3 points may be accrued at this stage. One point is assigned to areas with populations less than 1,000; 2 points are assigned to areas with populations between 1,000 and 10,000; and 3 points are assigned to areas with populations of 10,000 or greater. *Example - Population = 5853 is between 1000 to 10,000 and would be assigned 1 point.*
- b. Source Water Protection Areas within the priority area. The DEQ Policy Memorandum "Addressing Degraded Ground Water Quality Areas" directs DEQ to consider source water assessment areas in ranking the priority areas. Source water assessment areas, or "capture zones," represent the aerial extent of 3-, 6-, and 10-year travel times for ground water to reach the PWS well. If source water assessment/protection delineation touches a nitrate priority area, the susceptibility rating of the source water assessment is increased.

This stage provides 0, 1, or 2 points. Areas without a PWS well do not receive points. Areas with 1 to 20 PWS wells receive 1 point and areas with more than 20 PWS wells receive 2 points. *Example - PWS wells in Priority Area = 11 is between 1 and 20 and would be assigned 1 point.*

- c. Number of Wells with Nitrate Concentrations above 10 mg/L. The GWMTTC determined the number of wells with nitrate exceeding 10 mg/L was an important ranking factor. Furthermore, the number of sampled wells with nitrate greater than or equal to 10 mg/L within the priority area is representative of the potential for the public to ingest contaminated ground water. This step is intended to equalize the scoring of large populations drinking water from uncontaminated sources with small populations drinking water from nitrate contaminated sources. Nitrate contamination greater than or equal to 10 mg/L is the only factor tallied.

Points are accumulated as follows: 0 wells = 0 points, 1 to 2 wells = 1 point, 3 to 5 wells = 2 points, 6 to 9 wells = 3 points, 10 to 15 wells = 4 points, and greater than 15 wells = 5 points.

Example - Number of Wells with Nitrate greater than 10 = 29 wells is assigned 5 points.

At this stage the population scores are subtotaled. *Example - (2 + 1 + 5 = 8)*

- 2) **Water Quality** - This criterion considers the concentration of nitrate contamination with respect to drinking water standards. The criterion is based on the percent of sampled wells with ground water nitrate concentrations greater than or equal to 2 mg/L, 5mg/L, and 10 mg/L respectively. These categories were selected to maintain consistency with existing data formats used by the GWMTTC.
- a) Percentage of wells with groundwater nitrate concentrations greater than or equal to 2 mg/L. This concentration threshold provides an indication of human-caused (anthropogenic) impacts. The upper limit for naturally occurring (background) concentrations of nitrate is considered to be about 2 mg/L. Points are accumulated by multiplying the percentage of sampled wells by 2. *Example - 88% of the wells sampled equaled or exceeded 2 mg/l. ($0.88 \times 2 = 1.76$).*
 - b) Percentage of wells with ground water nitrate concentrations greater than or equal to 5 mg/L. This nitrate concentration is considered evidence of significant degradation. This concentration represents one half the drinking water standard for nitrate of 10 mg/L. Public drinking water systems are required to increase monitoring frequency when this level is reached. Because these wells are a subset of the wells containing nitrate greater than or equal to 2 mg/L, this percentage is always less than or equal to the percentage of wells above 2 mg/L. Points are accumulated by multiplying the percentage of sampled wells by 5. *Example - 73% of the wells sampled equaled or exceeded 5 mg/l. ($0.73 \times 5 = 3.65$).*
 - c) Percentage of wells with groundwater nitrate concentrations greater than or equal to 10 mg/L. State of Idaho and federal drinking water standard maximum contaminant level for nitrate is 10 mg/L. Nitrate concentrations above this level present health risks to certain individuals. Because these wells are a subset of the wells containing nitrate at or above 5 mg/L nitrate concentration, this percentage is always less than or equal to the percentage of wells greater than or equal to 5 mg/L. *Example - 45% of the wells sampled equaled or exceeded 10 mg/l. ($0.45 \times 10 = 4.50$).*

The sum of all three factors above gives the final water quality score.
Example - ($1.76 + 3.65 + 4.50 = 9.91$ points)

- 3) **Water Quality Trends** - This criterion considers water quality trends within each priority area. Determining water quality for a specific priority area is a complex process requiring a comprehensive analysis of water quality data. The IDWR evaluated the nitrate data using statistical methods to determine if scientifically defensible water quality trends are present in the areas. The concentrations of nitrate are classified as *increasing, no discernable trend, or decreasing*. Due to data limitations three (3) NPAs are listed with a trend of insufficient data. These three (3) NPAs were assigned to the no discernable trend category. The three NPAs are: Bruneau, Hagerman and Notus.

This criterion will be assigned a maximum value of 10 points. The scoring breakdown is listed below:

- a) Increasing = 10 points
- b) Static or no discernable trend = 5 points
- c) Decreasing = 0 points

Example – Increasing Nitrate Trend is assigned 10 points.

Secondary Criterion

- 4) **Other Beneficial Uses** - The "Other Beneficial Use" criterion is included in the process because DEQ policy states that this is to be a consideration in ranking the Nitrate Priority Areas. However, this factor does not appear to be an issue in any of the existing Nitrate Priority Areas with the exception of Twin Falls area aquaculture. When other beneficial uses are impacted, two points will be added to the score. Aquaculture is an example of a beneficial use potentially impacted by elevated nitrates.

Example - no other beneficial uses = 0 points

Total Score

The scoring format is to total the scores from the three (3) primary criteria subtotals and from the one (1) secondary criterion. Total scores are the sums of the population, water quality, water quality trend, and other beneficial uses. Total Scores are used to rank the NPAs and are displayed in Table 1.

Example: Total Score - $(8 + 9.91 + 10 + 0 = 27.9)$

For clarity the final score is rounded to the nearest tenth - 27.9

Tie Scores

Two of the areas; Minidoka and Clearwater Plateau, have identical scores of 19.2. During the July 2008 the GWMTC voted to use the median nitrate value as the tiebreaking criterion. Minidoka, with a median nitrate concentration 4.32 mg/L, was ranked 13; while Clearwater Plateau, with a median nitrate concentration of 3.70, was ranked 14.

2008 Ranking Results

Figure 1 shows a comparison of 2002 and 2008 Nitrate Priority Area delineations. Table 1 summarizes numerical factors, trend, and score with the rank for each area. Figure 2 illustrates the 2008 Nitrate Priority Areas statewide with the ranked list. Appendices 1 through 32 contain a map and ranking score sheet for each NPA.

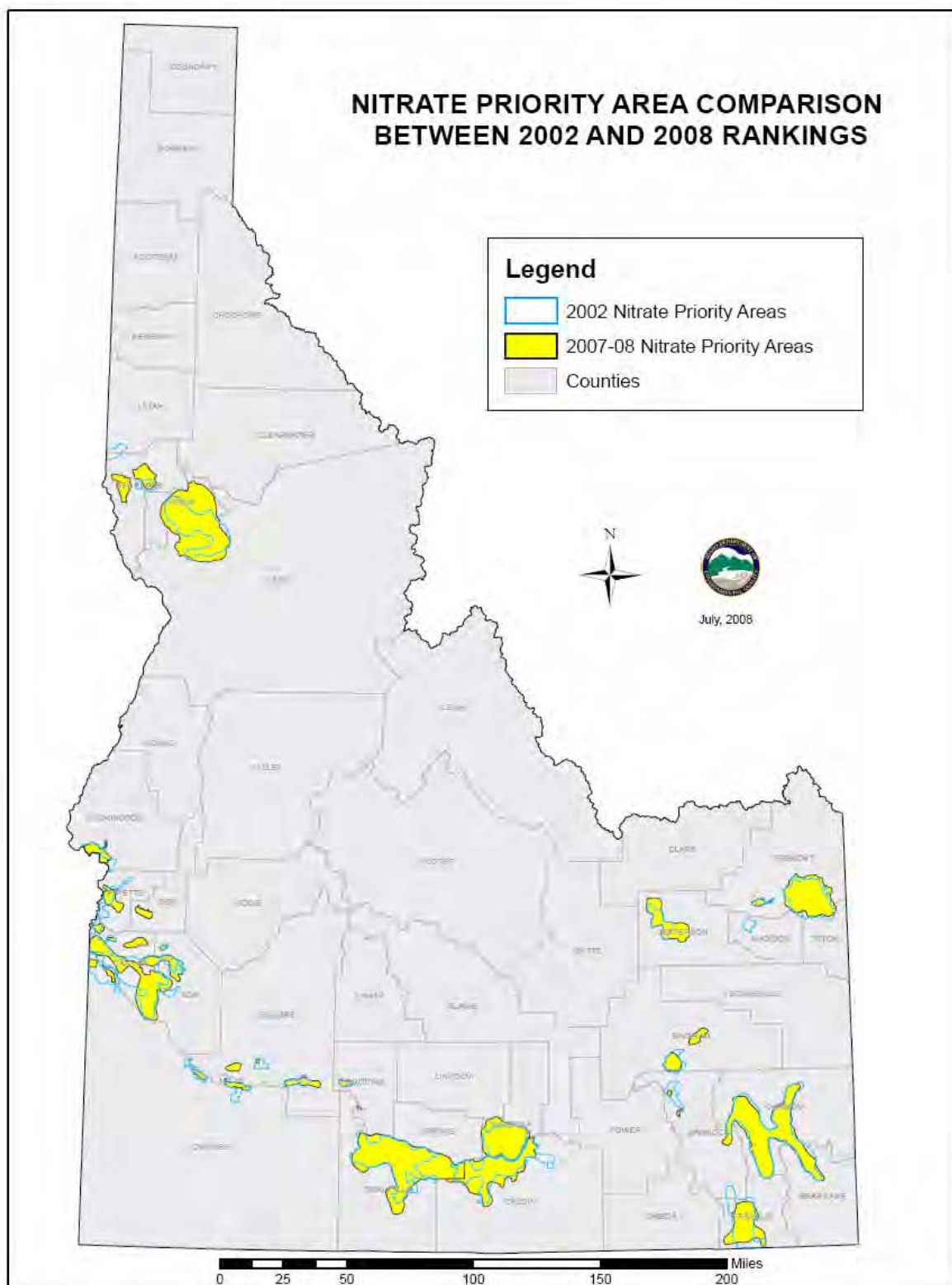


Figure 1. Comparison of 2002 and 2008 Nitrate Priority Area Delineations

Ranked Nitrate Priority Areas, 2008 (Preliminary)

AREA NAME	DEQ Region	Acres	Square Miles	Population	Total Samples*	MAX. NO3	Avg. NO3	MEDIAN	#>=2.0	%>=2.0	#>= 5.0	%>=5.0	#>=10.0	%>=10.0	#PWS/SWA	TREND	SCORE	RANK
TWIN FALLS	TFRO	379834	593.5	63354	605	41.0	5.2	4.9	536	88.6%	288	47.6%	34	5.6%	88	Increase	26.8	1
FORT HALL	PRO	23881	37.3	1783	8	24.1	14.8	14.8	8	100.0%	7	87.5%	7	87.5%	7	No Change	26.2	2
WEISER	BRO	25370	39.6	7258	99	43.5	12.3	12.0	86	86.9%	78	78.8%	58	58.6%	25	No Change	25.6	3
NE STAR	BRO	2585	4.0	166	63	48.0	11.1	7.7	42	86.7%	35	55.6%	27	42.9%	1	Increase	25.4	4
MARSING	BRO	6676	40.4	521	33	37.0	9.6	7.9	21	63.6%	19	57.6%	13	39.4%	12	Increase	25.0	5
ADA CANYON	BRO	211083	329.8	121063	933	55.9	5.3	4.1	701	75.1%	383	41.1%	108	11.6%	213	Increase	24.8	6
GRAND VIEW	BRO	5782	9.0	510	22	121.0	15.3	9.6	22	100.0%	20	90.9%	11	50.0%	2	No Change	22.6	7
CASSIA CO.	TFRO	193049	301.6	17525	384	40.0	6.3	5.7	331	86.2%	224	58.3%	65	16.9%	48	No Change	21.3	8
BRUNEAU	BRO	11271	17.6	23	4	110.0	43.4	31.7	3	75.0%	3	75.0%	3	75.0%	0	Insufficient	20.8	9
HAGERMAN	TFRO	1071	1.7	877	8	19.6	9.9	11.0	8	100.0%	5	62.5%	5	62.5%	4	Insufficient	20.5	10
ASHTON/DRUMMOND	IFRO	162473	253.9	2484	179	48.0	7.0	6.0	159	88.8%	124	69.3%	28	15.6%	18	No Change	19.8	11
LOWER PAYETTE	BRO	26829	41.9	6718	119	28.0	6.1	4.7	83	69.7%	57	47.9%	22	18.5%	25	No Change	19.7	12
MINIDOKA	TFRO	147501	230.5	18395	319	83.0	5.4	4.3	224	70.2%	131	41.1%	27	8.5%	56	No Change	19.3	13
CLEARWATER PLATEAU	LRO	359306	561.4	4236	183	77.1	6.8	3.7	119	65.0%	68	37.2%	39	21.3%	22	No Change	19.3	14
MOUNTAIN HOME	BRO	1175	1.8	10	35	40.0	10.0	5.8	29	82.9%	19	54.3%	10	28.6%	4	No Change	18.3	15
BLACKFOOT	PRO	15555	24.3	1100	15	16.0	7.0	5.6	15	100.0%	9	60.0%	3	20.0%	13	No Change	18.0	16
GLENNS FERRY	BRO	20678	32.3	1868	11	32.2	9.1	5.7	9	81.8%	8	72.7%	3	27.3%	4	No Change	18.0	17
MOUNTAIN HOME AFB	BRO	9242	14.4	8903	36	28.9	7.0	5.4	29	80.6%	20	55.6%	8	22.2%	8	No Change	17.6	18
PURPLE SAGE	BRO	13820	21.6	2835	87	22.7	5.3	4.6	66	75.9%	38	43.7%	9	10.3%	25	No Change	16.7	19
PRESTON	PRO	106721	166.8	8178	59	30.8	5.2	4.2	40	67.8%	24	40.7%	6	10.2%	23	No Change	16.4	20
LINDSAY CREEK	LRO	28296	44.2	1273	45	18.6	4.7	3.8	25	55.6%	18	40.0%	9	20.0%	16	No Change	16.1	21
GRACE/SODA SPRINGS	PRO	317245	495.7	8042	96	37.2	4.6	3.2	64	66.7%	28	29.2%	8	8.3%	45	No Change	15.6	22
MUD LAKE	IFRO	80980	126.5	1309	52	20.0	3.9	2.9	33	63.5%	14	26.9%	4	7.7%	11	No Change	15.4	23
MINK CREEK	PRO	1976	6.4	1478	40	21.0	4.6	2.4	24	60.0%	13	32.5%	8	20.0%	11	No Change	14.9	24
LAPWAI CREEK	LRO	34214	53.5	1026	16	18.7	5.6	5.2	13	81.3%	9	56.3%	2	12.5%	8	No Change	14.7	25
PARMA	BRO	7057	11.0	890	17	15.0	4.8	5.4	10	58.8%	9	52.9%	3	17.6%	3	No Change	14.6	26
ST. ANTHONY	IFRO	7693	12.0	666	14	42.6	9.5	3.3	9	64.3%	5	35.7%	3	21.4%	5	No Change	14.2	27
NOTUS	BRO	2674	4.2	135	6	10.2	5.8	6.9	5	83.3%	4	66.7%	1	16.7%	0	Insufficient	13.7	28
EMMETT NORTH BENCH	BRO	10693	16.7	887	27	17.0	4.7	3.7	19	70.4%	9	33.3%	3	11.1%	3	No Change	13.2	29
N. POCATELLO	PRO	1940	3.0	4464	11	8.9	4.6	3.8	11	100.0%	3	27.3%	0	0.0%	11	No Change	11.4	30
HOMEDALE	BRO	5585	8.7	387	24	16.0	4.7	1.5	12	50.0%	9	37.5%	5	20.8%	1	Decrease	8.9	31
BLISS	TFRO	6791	10.6	76	24	8.6	3.2	3.1	16	66.7%	7	29.2%	0	0.0%	0	No Change	8.8	32
TOTALS		2229048	3516.2	268420	3574				2772	77.6%	1698	47.2%	532	14.9%	712			
*Number of sample sites within nitrate priority area																		

Table 1. 2008 Ranked Nitrate Priority Areas with score components

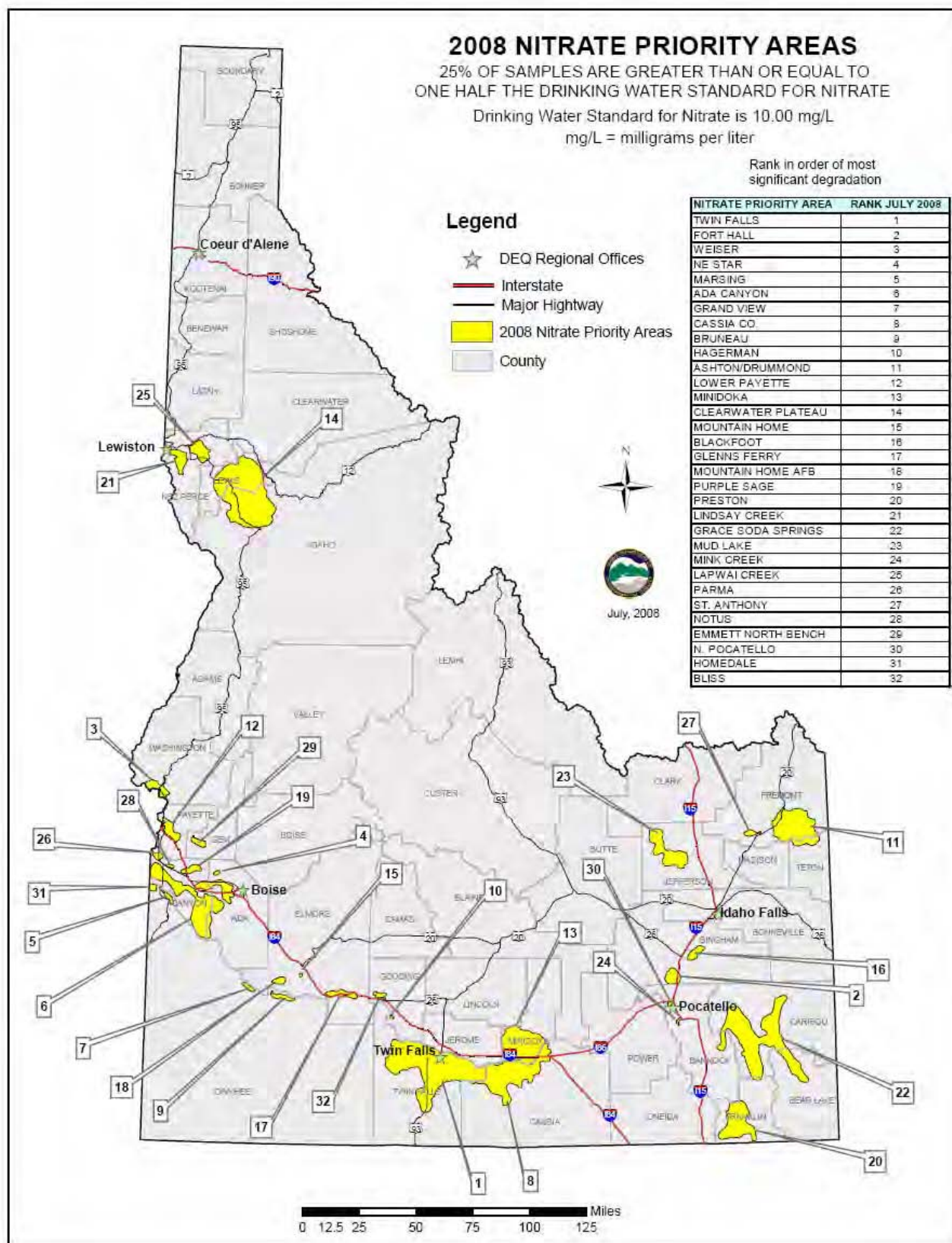


Figure 2. 2008 Nitrate Priority Areas statewide with the ranked list.